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CLAIMS

[Utility model registration claim]

[Claim 1] While recording a test signal on the power calibration area of a write once optical disk by the laser beam of two or more steps of mutually different power level It has the power calibration function to detect the optimal power level of a laser beam by reproducing these test signals. In the write once optical disk recording device which performs postscript record of various data to the data area of the aforementioned optical disk using the laser beam of the optimal power level detected by this power calibration operation The aforementioned power calibration area is equipped with two or more partitions which consist of two or more frames. A test-record means to record a test signal to the aforementioned frame by the laser beam of the power level of two or more mutually different step story at the time of the aforementioned power calibration operation, By reproducing a test signal and comparing this regenerative signal and target value in power level of each stage from the frame on which the test record was performed by the aforementioned test-record means It has an optimal power level detection means to detect the optimal power level, and a storage means to memorize the optimal power level detected by the aforementioned optimal power level detection means. The aforementioned test-record means can record a test signal now to the aforementioned frame by the laser beam of the power level in each stage which divided between the maximum of the output of the aforementioned laser beam, and the minimum values into plurality. The write once optical disk recording device characterized by performing a test record by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level memorized in the aforementioned storage means.

[Claim 2] The aforementioned test-record means is set in the 1st power calibration operation after a disk set. A test signal is recorded by the laser beam of the power level in all the stages from the maximum of the output of the aforementioned laser beam to the minimum value. In power calibration operation 2nd after after a disk set The write once optical disk recording device according to claim 1 characterized by performing a test record by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level detected in the last power calibration operation memorized by the aforementioned storage means.

[Claim 3] When the regenerative signal in the power level of each stage of the predetermined range before and after centering on the aforementioned optimal power level is larger than a target value The write once optical disk recording device according to claim 1 or 2 characterized by performing a test record by the laser beam of the predetermined stage where power level is more high when the regenerative signal in the power level of each stage of the predetermined range before and after the laser beam of the low predetermined stage of power level having performed the test record more and centering on the aforementioned optimal power level is smaller than a target value.

[Claim 4] The aforementioned test-record means can record a test signal now to the aforementioned frame by the laser beam of the power level in each stage which divided between the maximum of the power level of the aforementioned laser beam, and the minimum values into 15 stages. The write once optical disk recording device according to claim 1 to 3 characterized by performing a test record by the laser beam of the power level of 1 before and after centering on the optimal power level memorized in the aforementioned storage means stage.

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DETAILED DESCRIPTION

[Detailed explanation of a design]

[0001]

[The technical field to which a design belongs]

This design starts a write once optical disk at the write once optical disk recording device which carries out postscript record of the various data, and is related with the technology of attaining optimization of a record laser power especially.

[0002]

[Description of the Prior Art]

From the former, the write once optical disk (CD-(Compact Disk) WO (Write Once)) is known as an optical disk which can write in data only once. Moreover, generally the write once optical disk equipment which carries out postscript record of the data equips such an optical disk with the power calibration function to detect the optimal power level of a record laser beam, and in case postscript record of the data is carried out, power calibration operation called OPC (Optimum Power Control) is performed.

[0003]

Here, the composition of a write once optical disk and the conventional OPC operation are explained with reference to drawing 4. On the recording surface of an optical disk 2, the test-record field 50 (PCA is called Power Calibration Area and the following) for detecting the data area 46 for memorizing various data and the optimal power of a laser beam etc. is formed. PCA50 consists of test area 50a and count area 50b, and test area 50a consists of 100 partitions P001-P100. Moreover, each partition P001-P100 consists of 15 frames F1-F15. In one OPC operation, one of the partitions P001-P100 is used. While recording a test signal by 15 steps of laser powers to 15 frames F1-F15 contained in each of these partitions P001-P100 The test signal in each frame F1 - F15 is reproduced, this regenerative signal is compared with a target value, and the gradual laser power which corresponded is detected as optimal power level. Postscript record operation to a data area 46 is performed by the optimal power level detected by the above OPC operation.

[0004]

[Problem(s) to be Solved by the Device]

However, in the former, since one of the partitions P001-P100 is used for one OPC operation, in the optical disk 45 of one sheet, only a maximum of 100 OPC operation can be performed. For this reason, since it will be necessary to perform OPC operation whenever it records some files when the recording method which records data in a file unit like a packet-writing method, and can record the number of times of many conventionally is adopted, test area 50a was insufficient and there was a problem that there was a case where it becomes impossible to perform OPC operation.

[0005]

Moreover, for example, one partition is divided into three fields for every five frames, three test-record operation is performed to JP,7-287847,A to these three fields, and the operation of the power calibration area of the write once optical disk which enabled it to ask for the optimal power level certainly using one partition in one OPC operation by narrowing down the optimal power level from these 3 times of test-record results is shown. However, also in this method, since OPC operation cannot only be performed a maximum of 100 times, the problem said that a test area is insufficient is unsolvable.

[0006]

This design is made in order to solve the trouble mentioned above, and it aims at offering the write once optical disk recording device which can perform OPC operation of the number of times of many conventionally to the write once optical disk of one sheet by enabling it to perform OPC operation in area fewer than before.

[0007]

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, while this design records a test signal on the power calibration area of a write once optical disk by the laser beam of two or more steps of mutually different power level It has the power calibration function to detect the optimal power level of a laser beam by reproducing these test signals. In the write once optical disk recording device which performs postscript record of various data to the data area of an optical disk using the laser beam of the optimal power level detected by this power calibration operation Power calibration area is a thing equipped with two or more partitions which consist of two or more frames. A test-record means to record a test signal to a frame by the laser beam of the power level of two or more mutually different step story at the time of power calibration operation. From the frame on which the test record was performed by the test-record means by reproducing a test signal and comparing this regenerative signal and target value in power level of each stage It has an optimal power level detection means to detect the optimal power level, and a storage means to memorize the optimal power level detected by the optimal power level detection means. a test-record means A test signal can be recorded now to a frame by the laser beam of the power level in each stage which divided between the maximum of the output of a laser beam, and the minimum values into plurality. The laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level memorized in the storage means performs a test record.

[0008]

A test signal is recorded to a frame by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level detected in the last power calibration operation in this

composition, the regenerative signal and target value which reproduced these test signals are compared, what corresponded is detected as optimal power level, and postscript record operation is performed to a data area using the laser beam of this optimal power level. If this is made to perform a test record by the laser beam of the power level of about 1 stage focusing on the optimal power level detected in the last power calibration operation, the frame number used in one power calibration operation can be managed with three pieces, and it will become possible to perform one power calibration operation with a small number of frame. Therefore, in the write once optical disk of one sheet, it becomes possible to perform power calibration operation of the number of times of many.

[0009]

Moreover, the above-mentioned test-record means is set in the 1st power calibration operation after a disk set. A test signal is recorded by the laser beam of the power level in all the stages from the maximum of the output of a laser beam to the minimum value. In power calibration operation 2nd after after a disk set You may perform a test record by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level detected in the last power calibration operation memorized by the storage means.

[0010]

In the 1st power calibration operation after the write once optical disk was set in the recording device in this composition Record a test signal by the laser beam of the power level in all the stages from the maximum of the output of a laser beam to the minimum value, and the regenerative signal and reference signal which reproduced these test signals are compared. While detecting what corresponded as optimal power level and memorizing this optimal power level for a storage means, postscript record operation is performed to a data area using the laser beam of this optimal power level. Next, in power calibration operation of the 2nd henceforth, a test record is performed by the laser beam of the power level of the stage of the predetermined range before and after centering on the last optimal power level memorized by the storage means.

[0011]

Moreover, when the regenerative signal in the power level of each stage of the predetermined range when the regenerative signal in the power level of each stage of the predetermined range before and after centering on the above-mentioned optimal power level is larger than a target value, before and after the laser beam of the low predetermined stage of power level having performed the test record more and centering on the aforementioned optimal power level is smaller than a target value, the laser beam of the predetermined stage where power level is more high may perform a test record.

[0012]

Moreover, as for the above-mentioned test-record means, it is desirable that it is what performs a test record by the laser beam of the power level of 1 before and after centering on the optimal power level which can record a test signal now to a frame by the laser beam of the power level in each stage which divided between the maximum of the power level of a laser beam and the minimum values into 15 stages, and was memorized in the storage means stage.

[0013]

[The gestalt of implementation of a design]

Hereafter, the write once optical disk recording device by 1 operation gestalt of this design is explained with reference to a drawing. The electric composition of a write once optical disk recording device is shown in drawing 1. The write once optical disk recording device 1 has the power calibration function to detect the power level of the optimal record laser beam, and can record various data per file with a packet method using the laser beam of this optimal power level. The record control circuit 4 is connected to the central processing unit 3 (it is hereafter described as CPU) which manages control of the whole recording device 1, and this record control circuit 4 outputs a drive control signal to the laser drive circuit 6 and the servo circuit 7 in response to the control signal from CPU3, and the test signal from an encoder 5. An encoder 5 changes and outputs the information used as a write-in object to an EFM (Eight to Fourteen Modulation) signal. Moreover, it is a unit which changes the reflected light into an electrical signal and reproduces information while performing it, if an optical pickup 8 builds in semiconductor laser (un-illustrating), condenses the laser beam from this semiconductor laser and a laser beam is irradiated in the position of the target on an optical disk 2. The semiconductor laser of this optical pickup 8 is controlled by energization control from the laser drive circuit 6, and position control of this optical pickup 8 is performed by the servo circuit 7.

These record control circuit 4, an encoder 5, the laser drive circuit 6, the servo circuit 7, and an optical pickup 8 constitute the test-record means of this design.

[0014]

It amplifies and restores to the electrical signal from an optical pickup 8, and the signal from this RF amplifying circuit 10 is sent to CPU3 at the time of the usual reproduction operation, and the RF amplifying circuit 10 is sent to the beta detector 11 at the time of OPC operation. The optimal power level detection means of this design is constituted, and the beta detector 11 measures the peak value of RF signal inputted from the RF amplifying circuit 10, i.e., the maximal value A and the minimal value B, and, as for the beta detector 11 and a comparator circuit 12, detects a beta value (regenerative signal) by the following formula.

Beta value $= (A+B)/(A-B)$

Moreover, the beta value detected in this beta detector 11 is compared with the beta value made into a target value in CPU3 (optimal power level detection means). RAM14 (storage means) memorizes the optimal power level detected in OPC operation. Moreover, CD tray open/close switch 17 for taking the roll control circuit 16 which controls the motor 15 made to rotate an optical disk 2, and the tray on which an optical disk 2 is put in and out is connected to CPU3.

[0015]

Next, the flow chart which shows OPC operation of the write once optical disk recording device 1 to drawing 2 for the composition of an optical disk is shown in drawing 3, and OPC operation of the write once optical disk recording device 1 which becomes with the above-mentioned composition with reference to these is explained. As shown in drawing 2, test area 50a of PCA50 is divided into 100 partitions P001-P100, and each partitions P001-P100 consist of 15 frames F1-F15. This OPC operation is performed at any time, whenever some files are recorded in case postscript record of the various data to the data area 46 of a write once optical disk 2 is started or.

[0016]

If a write once optical disk 2 is put on a tray, CD tray open/close switch 17 is operated and a write once optical disk 2 is set, first, after CPU3 sets a laser power as initial value, it will be searched to test area 50a of PCA (S1), and will record a test signal by the laser beam of 15 steps of power level to 15 frames F1-F15 which constitute a partition

P001 (S2). The power level at this time is 15 steps of power level PW1-PW15 of having divided between the maximum of the output of a laser beam, and the minimum values into 15. Next, the test signal recorded on these frames F1-F15 is reproduced, the beta value which can be set each power level PW1-PW15 by the beta detector 11 is computed, this beta value is compared in the beta value and CPU3 which are made into a target value, and the power level corresponding [both] is determined as optimal power level (S3). While the 1st OPC operation is completed above and performing postscript record of various data to the data area 46 of an optical disk 2 by the laser beam of this optimal power level, this optimal power level is memorized to RAM14 (S4). In addition, PW7 is made into the optimal power level in drawing 2.

[0017]

Next, if a file is partly recorded on a data area 46 by the packet method, 2nd OPC operation will be performed. In this OPC operation, CPU3 performs a test record to three frames F1-F3 of the 2nd partition P002 by the laser beam which has the power level PW6-PW8 of about 1 level focusing on the optimal power level PW7 memorized by RAM14 (S5). The test signal recorded on these three frames F1-F3 is reproduced, and a beta value is computed (S6). Here, when one of these three beta values is in agreement with a target value, the power level in YES) and the congruous beta values is determined as optimal power level by (S7 (S8). The 2nd OPC operation is completed above and postscript record is performed to a data area 46 by the laser beam of this optimal power level (S9).

[0018]

S7 -- setting -- any of three beta values -- although -- the case of not being in agreement with a target value -- (it progresses to NO) and S8 by S7 As it judges that the power level of NO) and a test signal was too low at (S11 here when three beta values are smaller than a target value, and shown in drawing 2 After the laser beam (PW9-PW11) of three steps with power level higher than previously performs a test record to three frames F4-F6 (S12), it returns to S6 and calculation of a beta value and comparison with the target value of a beta value are performed again. On the other hand, when three beta values are larger than a target value, after it judges that the power level of YES) and a test signal was too high at (S11 and the laser beam of the step of three lows of power level performs a test record to three frames in S11 rather than previously (S13), it returns to S6.

[0019]

CD tray open/close switch 17 is not operated, but when the same optical disk 2 is set in equipment, it returns to NO) and S5 by (S10, and the laser beam of the power level of a three-stage as shown in above-mentioned S5-above-mentioned S13 performs OPC operation using three frames. On the other hand, CD tray open/close switch 17 is operated, when it is detected that the optical disk 2 was taken out, it returns to S1 and the laser beam of 15 steps of power level PW1-PW15 performs OPC operation again using 15 frames.

[0020]

Thus, since the power level of 1 before and after memorizing the optimal power level obtained by the last OPC operation and centering on this optimal power level stage was made to perform a test record, only three frames have a test record used in OPC operation of the 2nd henceforth. Since one OPC operation can be performed by test area 50a fewer than before by this, it becomes possible to perform OPC operation of the number of times of many conventionally by the write once optical disk 2 of one sheet. Moreover, when a recording method like a packet-writing method is adopted, the situation where test area 50a runs short does not occur.

[0021]

Moreover, since power level is adjusted and it was made to perform a test record with the power level of a predetermined stage again even when the beta value computed through beta detector in the regenerative signal was not in agreement with a target value, the detection mistake of the optimal power level can be lost and the record mistake by the mistaken power can be reduced.

[0022]

In addition, this design is not restricted to the above-mentioned operation gestalt, but various deformation is possible for it. For example, in the above-mentioned operation gestalt, in OPC operation of the 2nd henceforth, although the laser beam of the power level of 1 before and after centering on the optimal power level obtained in the last OPC operation stage shall perform test-record operation, this design is not restricted to this and may perform a test record by the laser beam of two or more steps of power level focusing on the optimal power level approximately.

[0023]

[Effect of the Device]

As mentioned above, according to the write once optical disk recording device concerning this design, the optimal power level obtained by the last power calibration operation is memorized. Since the power level of the stage of the predetermined range before and after centering on this optimal power level was made to perform a test record It becomes possible to perform one power calibration operation in a power calibration area field fewer than before, and it becomes possible to perform power calibration operation of the number of times of many conventionally to the write once optical disk of one sheet. By this, when the recording method of a packet-writing method is adopted, a test area is insufficient, and generating of the situation where it becomes impossible to perform power calibration operation can be prevented.

[0024]

Moreover, it sets in the 1st power calibration operation. Perform a test record with the power level in all stages, and it sets in power calibration operation of the 2nd henceforth. By performing a test record with the power level of the predetermined range before and after centering on the optimal power detected in the last power calibration operation In power calibration operation of the 2nd henceforth, it becomes possible to perform one power calibration operation by the test area fewer than before, and the same effect as the above-mentioned claim 1 can be acquired.

[0025]

Moreover, even when a regenerative signal is not in agreement with a reference signal, by adjusting power level and performing a test record with the power level of a predetermined stage again, the detection mistake of the optimal power level can be lost and the record mistake by the mistaken power can be reduced.

[0026]

A test-record means moreover, by performing a test record with the power level of 1 before and after being able to perform test-record operation and centering on the optimal power level by the laser beam of 15 steps of power level stage Since it becomes possible to perform one power calibration operation with three frames, it becomes possible to perform power calibration operation of the number of times of many conventionally to the write once optical disk of

one sheet, and the same effect as the above-mentioned claim 1 can be acquired.

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TECHNICAL FIELD

[The technical field to which a design belongs]

This design starts a write once optical disk at the write once optical disk recording device which carries out postscript record of the various data, and is related with the technology of attaining optimization of a record laser power especially.

[0002]

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PRIOR ART

[Description of the Prior Art]

From the former, the write once optical disk (CD-(Compact Disk) WO (Write Once)) is known as an optical disk which can write in data only once. Moreover, generally the write once optical disk equipment which carries out postscript record of the data equips such an optical disk with the power calibration function to detect the optimal power level of a record laser beam, and in case postscript record of the data is carried out, power calibration operation called OPC (Optimum Power Control) is performed.

[0003]

Here, the composition of a write once optical disk and the conventional OPC operation are explained with reference to drawing 4. On the recording surface of an optical disk 2, the test-record field 50 (PCA is called PCA:Power Calibration Area and the following) for detecting the data area 46 for memorizing various data and the optimal power of a laser beam etc. is formed. PCA50 consists of test area 50a and count area 50b, and test area 50a consists of 100 partitions P001-P100. Moreover, each partition P001-P100 consists of 15 frames F1-F15. In one OPC operation, one of the partitions P001-P100 is used. While recording a test signal by 15 steps of laser powers to 15 frames F1-F15 contained in each of these partitions P001-P100 The test signal in each frame F1 - F15 is reproduced, this regenerative signal is compared with a target value, and the gradual laser power which corresponded is detected as optimal power level. Postscript record operation to a data area 46 is performed by the optimal power level detected by the above OPC operation.

[0004]

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EFFECT OF THE INVENTION

[Effect of the Device]

As mentioned above, according to the write once optical disk recording device concerning this design, it is the last power calibration operation. Since the power level of the stage of the predetermined range before and after memorizing the obtained optimal power level and centering on this optimal power level was made to perform a test record, it becomes possible to perform one power calibration operation in a power calibration area field fewer than before, and it becomes possible to perform power calibration operation of the number of times of many conventionally to the write once optical disk of one sheet. By this, when the recording method of a packet-writing method is adopted, a test area is insufficient, and generating of the situation where it becomes impossible to perform power calibration operation can be prevented.

[0024]

Moreover, it sets in the 1st power calibration operation. Perform a test record with the power level in all stages, and it sets in power calibration operation of the 2nd henceforth. By performing a test record with the power level of the predetermined range before and after centering on the optimal power detected in the last power calibration operation. In power calibration operation of the 2nd henceforth, it becomes possible to perform one power calibration operation by the test area fewer than before, and the same effect as the above-mentioned claim 1 can be acquired.

[0025]

Moreover, even when a regenerative signal is not in agreement with a reference signal, by adjusting power level and performing a test record with the power level of a predetermined stage again, the detection mistake of the optimal power level can be lost and the record mistake by the mistaken power can be reduced.

[0026]

Moreover, a test-record means is performing a test record with the power level of 1 before and after being able to perform test-record operation and centering on the optimal power level by the laser beam of 15 steps of power level stage. Since it becomes possible to perform one power calibration operation with three frames, it becomes possible to perform power calibration operation of the number of times of many conventionally to the write once optical disk of one sheet, and the same effect as the above-mentioned claim 1 can be acquired.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Device]

However, in the former, since one of the partitions P001-P100 is used for one OPC operation, in the optical disk 45 of one sheet, only a maximum of 100 OPC operation can be performed. For this reason, since it will be necessary to perform OPC operation whenever it records some files when the recording method which records data in a file unit like a packet-writing method, and can record the number of times of many conventionally is adopted, test area 50a was insufficient and there was a problem that there was a case where it becomes impossible to perform OPC operation.

[0005]

Moreover, for example, in JP,7-287847,A, it is. One partition is divided into three fields for every five frames, three test-record operation is performed to these three fields, and the operation of the power calibration area of the write once optical disk which enabled it to ask for the optimal power level certainly using one partition in one OPC operation by narrowing down the optimal power level from these 3 times of test-record results is shown. However, also in this method, since OPC operation cannot only be performed a maximum of 100 times, the problem said that a test area is insufficient is unsolvable.

[0006]

This design is made in order to solve the trouble mentioned above, and it aims at offering the write once optical disk recording device which can perform OPC operation of the number of times of many conventionally to the write once optical disk of one sheet by enabling it to perform OPC operation in area fewer than before.

[0007]

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MEANS

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, while this design records a test signal on the power calibration area of a write once optical disk by the laser beam of two or more steps of mutually different power level. It has the power calibration function to detect the optimal power level of a laser beam by reproducing these test signals. In the write once optical disk recording device which performs postscript record of various data to the data area of an optical disk using the laser beam of the optimal power level detected by this power calibration operation. Power calibration area is a thing equipped with two or more partitions which consist of two or more frames. A test-record means to record a test signal to a frame by the laser beam of the power level of two or more mutually different step story at the time of power calibration operation. From the frame on which the test record was performed by the test-record means by reproducing a test signal and comparing this regenerative signal and target value in power level of each stage. It has an optimal power level detection means to detect the optimal power level, and a storage means to memorize the optimal power level detected by the optimal power level detection means. A test-record means A test signal can be recorded now to a frame by the laser beam of the power level in each stage which divided between the maximum of the output of a laser beam, and the minimum values into plurality. The laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level memorized in the storage means performs a test record.

[0008]

A test signal is recorded to a frame by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level detected in the last power calibration operation in this composition, the regenerative signal and target value which reproduced these test signals are compared, what corresponded is detected as optimal power level, and postscript record operation is performed to a data area using the laser beam of this optimal power level. If this is made to perform a test record by the laser beam of the power level of about 1 stage focusing on the optimal power level detected in the last power calibration operation, the frame number used in one power calibration operation can be managed with three pieces, and it will become possible to perform one power calibration operation with a small number of frame. Therefore, in the write once optical disk of one sheet, it becomes possible to perform power calibration operation of the number of times of many.

[0009]

Moreover, the above-mentioned test-record means is set in the 1st power calibration operation after a disk set. A test signal is recorded by the laser beam of the power level in all the stages from the maximum of the output of a laser beam to the minimum value. In power calibration operation 2nd after after a disk set You may perform a test record by the laser beam of the power level of the stage of the predetermined range before and after centering on the optimal power level detected in the last power calibration operation memorized by the storage means.

[0010]

In the 1st power calibration operation after the write once optical disk was set in the recording device in this composition Record a test signal by the laser beam of the power level in all the stages from the maximum of the output of a laser beam to the minimum value, and the regenerative signal and reference signal which reproduced these test signals are compared. While detecting what corresponded as optimal power level and memorizing this optimal power level for a storage means, postscript record operation is performed to a data area using the laser beam of this optimal power level. Next, in power calibration operation of the 2nd henceforth, a test record is performed by the laser beam of the power level of the stage of the predetermined range before and after centering on the last optimal power level memorized by the storage means.

[0011]

Moreover, when the regenerative signal in the power level of each stage of the predetermined range when the regenerative signal in the power level of each stage of the predetermined range before and after centering on the above-mentioned optimal power level is larger than a target value, before and after the laser beam of the low predetermined stage of power level having performed the test record more and centering on the aforementioned optimal power level is smaller than a target value, the laser beam of the predetermined stage where power level is more high may perform a test record.

[0012]

Moreover, as for the above-mentioned test-record means, it is desirable that it is what performs a test record by the laser beam of the power level of 1 before and after centering on the optimal power level which can record a test signal now to a frame by the laser beam of the power level in each stage which divided between the maximum of the power level of a laser beam and the minimum values into 15 stages, and was memorized in the storage means stage.

[0013]

[The gestalt of implementation of a design]

Hereafter, the write once optical disk recording device by 1 operation gestalt of this design is explained with reference to a drawing. The electric composition of a write once optical disk recording device is shown in drawing 1. The write once optical disk recording device 1 has the power calibration function to detect the power level of the optimal record laser beam, and can record various data per file with a packet method using the laser beam of this optimal power level. The record control circuit 4 is connected to the central processing unit 3 (it is hereafter described as CPU) which manages control of the whole recording device 1, and this record control circuit 4 outputs a drive control signal to the laser drive circuit 6 and the servo circuit 7 in response to the control signal from CPU3, and the test signal from an

encoder 5. An encoder 5 changes and outputs the information used as a write-in object to an EFM (Eight to Fourteen Modulation) signal. Moreover, it is a unit which changes the reflected light into an electrical signal and reproduces information while performing it, if an optical pickup 8 builds in semiconductor laser (un-illustrating), condenses the laser beam from this semiconductor laser and a laser beam is irradiated in the position of the target on an optical disk 2. The semiconductor laser of this optical pickup 8 is controlled by energization control from the laser drive circuit 6, and position control of this optical pickup 8 is performed by the servo circuit 7. These record control circuit 4, an encoder 5, the laser drive circuit 6, the servo circuit 7, and an optical pickup 8 constitute the test-record means of this design.

[0014]

It amplifies and restores to the electrical signal from an optical pickup 8, and the signal from this RF amplifying circuit 10 is sent to CPU3 at the time of the usual reproduction operation, and the RF amplifying circuit 10 is sent to the beta detector 11 at the time of OPC operation. The optimal power level detection means of this design is constituted, and the beta detector 11 measures the peak value of RF signal inputted from the RF amplifying circuit 10, i.e., the maximal value A and the minimal value B, and, as for the beta detector 11 and a comparator circuit 12, detects a beta value (regenerative signal) by the following formula.

Beta value $=(A+B)/(A-B)$

Moreover, the beta value detected in this beta detector 11 is CPU3.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the electric composition of the write once optical disk recording device by 1 operation gestalt of this design.

[Drawing 2] It is drawing for explaining OPC operation to the test area of a write once optical disk.

[Drawing 3] It is the flow chart which shows OPC operation of a write once optical disk recording device.

[Drawing 4] It is drawing for explaining OPC operation to the test area of the conventional write once optical disk.

[Description of Notations]

1 Write Once Optical Disk Recording Device

2 Write Once Optical Disk

3 CPU (Optimal Power Level Detection Means)

4 Record Control Circuit (Test-Record Means)

5 Encoder (Test-Record Means)

6 Laser Drive Circuit (Test-Record Means)

7 Servo Circuit (Test-Record Means)

8 Optical Pickup (Test-Record Means)

11 Beta Detector

14 RAM (Storage Means)

50 Power Calibration Area

P001-P100 Partition

F1-F15 Frame

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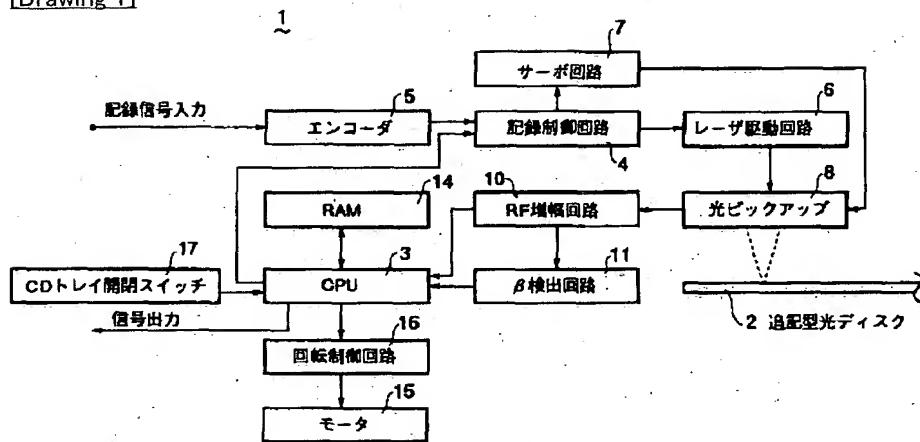
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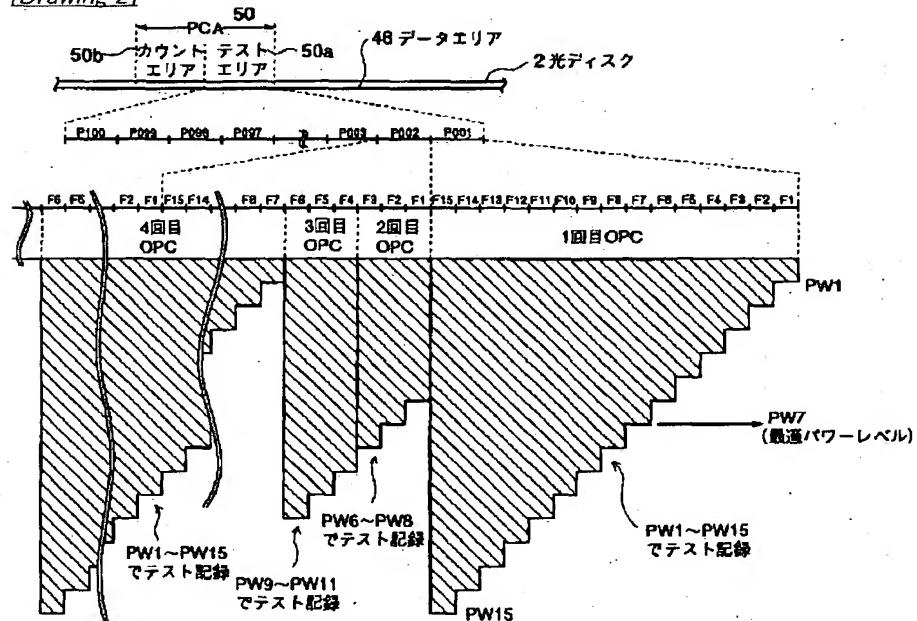
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DRAWINGS

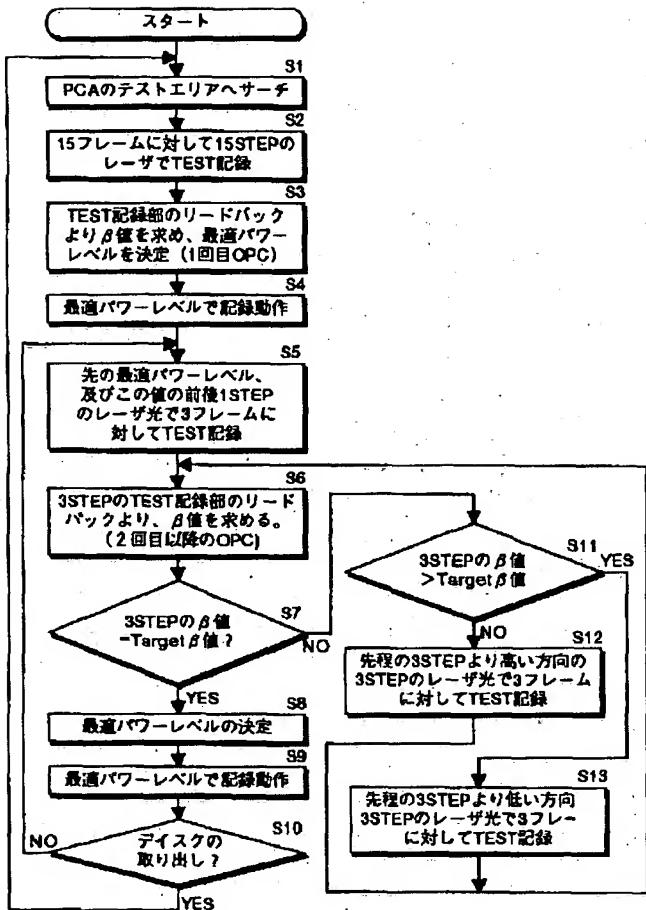
[Drawing 1]



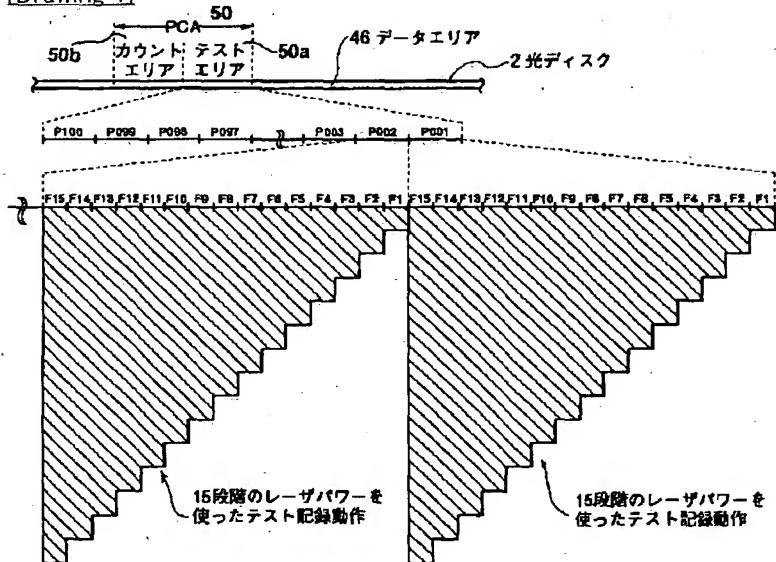
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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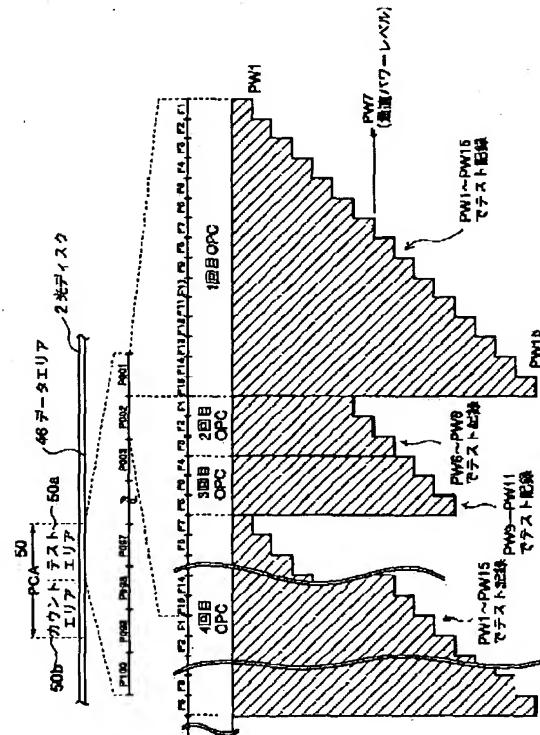
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(54)【考案の名称】 追記型光ディスク記録装置

(57)【要約】

【課題】 追記型光ディスクに各種データを追記記録する追記型光ディスク記録装置において、1枚の追記型光ディスクに対して従来よりも多回数のOPC動作を行うことができるようとする。

【解決手段】 前回のパワーキャリブレーション動作において検出された最適パワーレベルを中心とした前後1段階のパワーレベルのシーザ光によりフレームに対してテスト信号を記録するようにした。これにより、1回のパワーキャリブレーション動作において用いられるフレーム数は3個で済み、少数のフレームで1回のパワーキャリブレーション動作を行うことが可能となるので、1枚の追記型光ディスクにおいて、多回数のパワーキャリブレーション動作を行うことが可能となる。



【実用新案登録請求の範囲】

【請求項1】 追記型光ディスクのパワーキャリブレーションエリアに互いに異なる2段階以上のパワーレベルのレーザ光でテスト信号を記録すると共に、これらテスト信号を再生することにより、レーザ光の最適パワーベルを検出するパワーキャリブレーション機能を備え、このパワーキャリブレーション動作により検出された最適パワーベルのレーザ光を用いて前記光ディスクのデータエリアに各種データの追記記録を行う追記型光ディスク記録装置において、

前記パワーキャリブレーションエリアは、複数個のフレームからなるパーティションを複数個備えるものであり、

前記パワーキャリブレーション動作時に、互いに異なる複数段階のパワーレベルのレーザ光で前記フレームに対してテスト信号を記録するテスト記録手段と、前記テスト記録手段によりテスト記録が行われたフレームからテスト信号を再生し、各段階のパワーレベルにおける該再生信号とターゲット値とを比較することにより、最適パワーレベルを検出する最適パワーレベル検出手段と、

前記最適パワーレベル検出手段によって検出された最適パワーレベルを記憶する記憶手段とを備え、

前記テスト記録手段は、前記レーザ光の出力の最大値と最小値との間を複数個に分割した各段階におけるパワーレベルのレーザ光で前記フレームに対してテスト信号を記録し得るようになっており、前記記憶手段内に記憶された最適パワーレベルを中心とした前後所定範囲の段階のパワーベルのレーザ光によりテスト記録を行うものとしたことを特徴とする追記型光ディスク記録装置。

【請求項2】 前記テスト記録手段は、ディスクセット後の1回目のパワーキャリブレーション動作においては、前記レーザ光の出力の最大値から最小値までの全ての段階におけるパワーベルのレーザ光でテスト信号を記録し、ディスクセット後の2回目以降のパワーキャリブレーション動作においては、前記記憶手段に記憶されている前回のパワーキャリブレーション動作において検出された最適パワーベルを中心とした前後所定範囲の段階のパワーレベルのレーザ光でテスト記録を行うものとしたことを特徴とする請求項1に記載の追記型光ディスク記録装置。

【請求項3】 前記最適パワーレベルを中心とした前後

所定範囲の各段階のパワーレベルにおける再生信号がターゲット値よりも大きい場合には、よりパワーベルの低い所定段階のレーザ光によりテスト記録を行い、また、前記最適パワーレベルを中心とした前後所定範囲の各段階のパワーベルにおける再生信号がターゲット値よりも小さい場合には、よりパワーレベルの高い所定段階のレーザ光によりテスト記録を行うようにしたことを特徴とする請求項1又は請求項2に記載の追記型光ディスク記録装置。

【請求項4】 前記テスト記録手段は、前記レーザ光のパワーレベルの最大値と最小値との間を15段階に分割した各段階におけるパワーレベルのレーザ光で前記フレームに対してテスト信号を記録し得るようになっており、前記記憶手段内に記憶された最適パワーベルを中心とした前後1段階のパワーレベルのレーザ光によりテスト記録を行うものとしたことを特徴とする請求項1乃至請求項3のいずれかに記載の追記型光ディスク記録装置。

【図面の簡単な説明】

【図1】 本考案の一実施形態による追記型光ディスク記録装置の電気的構成を示すブロック図である。

【図2】 追記型光ディスクのテストエリアに対するOPC動作を説明するための図である。

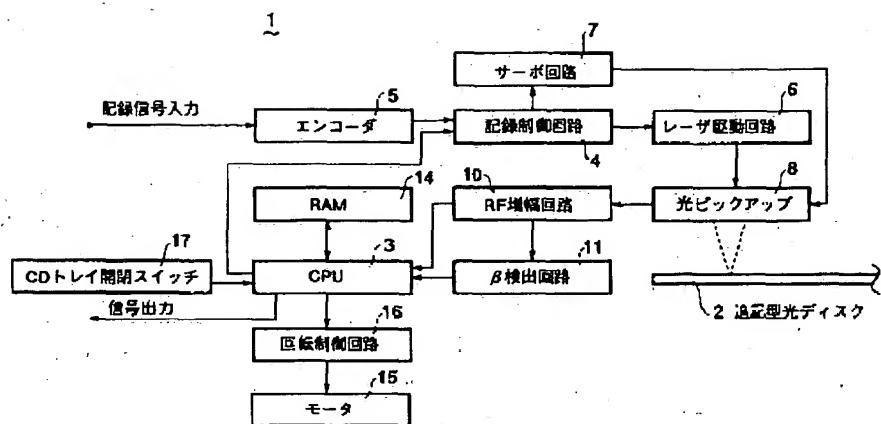
【図3】 追記型光ディスク記録装置のOPC動作を示すフローチャートである。

【図4】 従来の追記型光ディスクのテストエリアに対するOPC動作を説明するための図である。

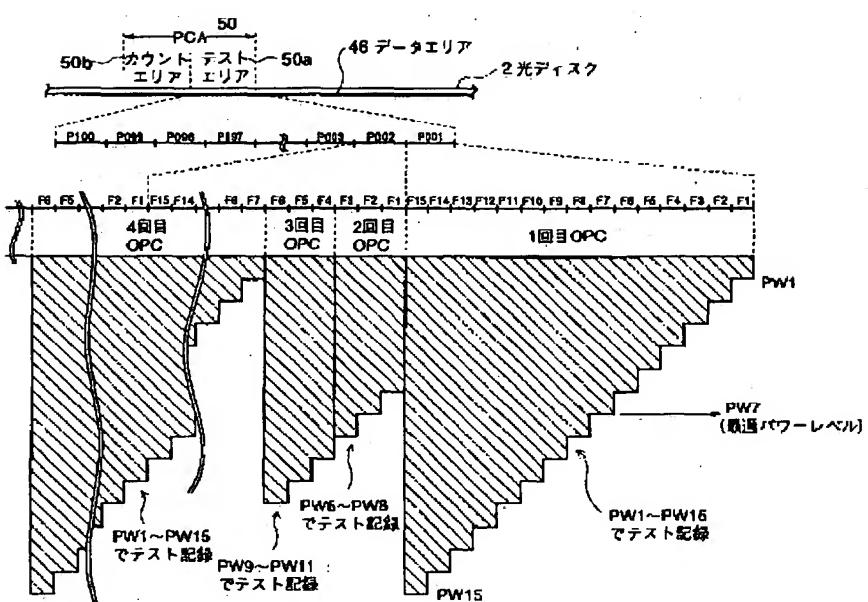
【符号の説明】

- 1 追記型光ディスク記録装置
- 2 追記型光ディスク
- 3 CPU (最適パワーレベル検出手段)
- 4 記録制御回路 (テスト記録手段)
- 5 エンコーダ (テスト記録手段)
- 6 レーザ駆動回路 (テスト記録手段)
- 7 サーボ回路 (テスト記録手段)
- 8 光ビックアップ (テスト記録手段)
- 11 β検出手路
- 14 RAM (記憶手段)
- 50 パワーキャリブレーションエリア
- P001～P100 パーティション
- F1～F15 フレーム

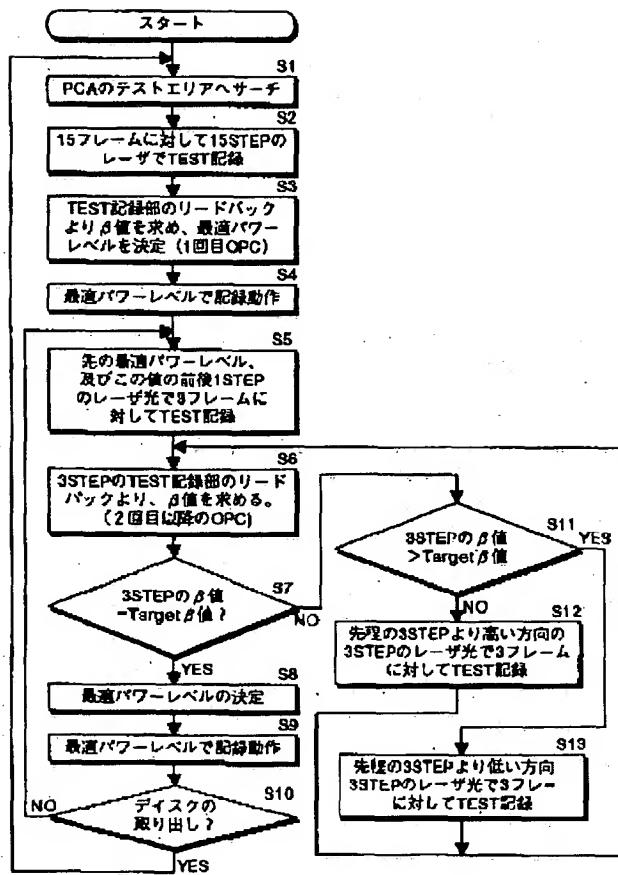
【図1】



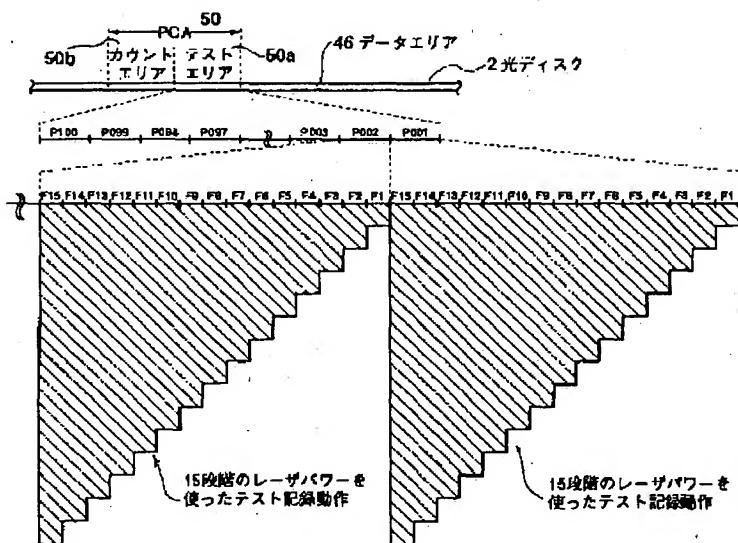
【図2】



【図3】



【図4】



【考案の詳細な説明】

【0001】

【考案の属する技術分野】

本考案は、追記型光ディスクに各種データを追記記録する追記型光ディスク記録装置に係り、特に、記録レーザパワーの最適化を図る技術に関するものである。

【0002】

【従来の技術】

従来から、一度のみのデータの書き込みが可能な光ディスクとして、追記型光ディスク (C D (Compact Disk) - W O (Write Once)) が知られている。また、このような光ディスクにデータを追記記録する追記型光ディスク装置は、一般的に、記録レーザ光の最適パワーベルを検出するパワーキャリブレーション機能を備えており、データを追記記録する際には、O P C (Optimum Power Control) と呼ばれるパワーキャリブレーション動作を行っている。

【0003】

ここで、追記型光ディスクの構成と従来のO P C動作について図4を参照して説明する。光ディスク2の記録面上には、各種データを記憶するためのデータエリア46、シーザ光の最適パワーを検出するためのテスト記録領域50 (P C A : Power Calibration Area、以下、P C Aと称する) 等が設けられている。P C A 50はテストエリア50aとカウントエリア50bとから成るものであり、テストエリア50aは100個のパーティションP 0 0 1～P 1 0 0 から構成されている。また、それぞれのパーティションP 0 0 1～P 1 0 0は15個のフレームF 1～F 1 5で構成されている。1回のO P C動作では、パーティションP 0 0 1～P 1 0 0の1つが使用されるようになっており、これらパーティションP 0 0 1～P 1 0 0の各々に含まれる15個のフレームF 1～F 1 5に対して15段階のレーザパワーでテスト信号を記録すると共に、それぞれのフレームF 1～F 1 5内のテスト信号を再生し、この再生信号とターゲット値とを比較して、両者が一致した段階のレーザパワーを最適パワーベルとして検出する。データエリア46に対する追記記録動作は、以上のようなO P C動作によって検出された

最適パワーレベルにより行われる。

【0004】

【考案が解決しようとする課題】

しかしながら、従来においては、1回のO P C動作にパーティションP 0 0 1～P 1 0 0の1つを使用するため、一枚の光ディスク45においては、最高で100回のO P C動作しか行うことができない。このため、パケットライト方式のようなファイル単位でデータを記録して、従来よりも多回数の記録を行い得るような記録方式を採用した場合には、数個のファイルを記録する毎にO P C動作を行う必要が生じるため、テストエリア50aが不足して、O P C動作を行うことができなくなる場合があるという問題があった。

【0005】

また、例えば、特開平7-287847号公報には、1つのパーティションを5フレーム毎の3つの領域に分割し、これら3つの領域に対して3回のテスト記録動作を行い、これら3回のテスト記録結果から最適パワーレベルを絞り込むことで、1回のO P C動作において1個のパーティションを使って確実に最適パワーレベルを求める能够性を示すようにした追記型光ディスクのパワーキャリブレーションエリアの使用方法が示されている。ところが、この方法においても、最高100回までしかO P C動作を行うことができないため、テストエリアの不足と言う問題を解決することはできない。

【0006】

本考案は、上述した問題点を解決するためになされたものであり、従来よりも少ないエリアでO P C動作を行うことができるようにより、1枚の追記型光ディスクに対して従来よりも多回数のO P C動作を行うことができる追記型光ディスク記録装置を提供することを目的とする。

【0007】

【課題を解決するための手段】

上記目的を達成するために、本考案は、追記型光ディスクのパワーキャリブレーションエリアに亘りに異なる2段階以上のパワーレベルのレーザ光でテスト信号を記録すると共に、これらテスト信号を再生することにより、レーザ光の最適

パワーレベルを検出するパワーキャリブレーション機能を備え、このパワーキャリブレーション動作により検出された最適パワーンベルのレーザ光を用いて光ディスクのデータエリアに各種データの追記記録を行う追記型光ディスク記録装置において、パワーキャリブレーションエリアは、複数個のフレームからなるパーティションを複数個備えるものであり、パワーキャリブレーション動作時に、互いに異なる複数段階のパワーンベルのレーザ光でフレームに対してテスト信号を記録するテスト記録手段と、テスト記録手段によりテスト記録が行われたフレームからテスト信号を再生し、各段階のパワーンベルにおける該再生信号とターゲット値とを比較することにより、最適パワーンベルを検出する最適パワーレベル検出手段と、最適パワーレベル検出手段によって検出された最適パワーレベルを記憶する記憶手段とを備え、テスト記録手段は、レーザ光の出力の最大値と最小値との間を複数個に分割した各段階におけるパワーレベルのレーザ光でフレームに対してテスト信号を記録し得るようになっており、記憶手段内に記憶された最適パワーレベルを中心とした前後所定範囲の段階のパワーレベルのレーザ光によりテスト記録を行うものである。

【0008】

この構成においては、前回のパワーキャリブレーション動作において検出された最適パワーンベルを中心とした前後所定範囲の段階のパワーンベルのレーザ光によりフレームに対してテスト信号を記録し、これらテスト信号を再生した再生信号とターゲット値とを比較して、両者が一致したものを最適パワーレベルとして検出し、この最適パワーレベルのレーザ光を用いてデータエリアに対して追記記録動作を行う。これにより、例えば、前回のパワーキャリブレーション動作において検出された最適パワーンベルを中心として前後1段階のパワーレベルのレーザ光でテスト記録を行うようにすれば、1回のパワーキャリブレーション動作において用いられるフレーム数は3個で済み、少数のフレームで1回のパワーキャリブレーション動作を行うことが可能となる。従って、1枚の追記型光ディスクにおいて、多回数のパワーキャリブレーション動作を行うことが可能となる。

【0009】

また、上記テスト記録手段は、ディスクセット後の1回目のパワーキャリブレ

ーション動作においては、レーザ光の出力の最大値から最小値までの全ての段階におけるパワーベルのレーザ光でテスト信号を記録し、ディスクセット後の2回目以降のパワーキャリブレーション動作においては、記憶手段に記憶されている前回のパワーキャリブレーション動作において検出された最適パワーレベルを中心とした前後所定範囲の段階のパワーレベルのシーザ光でテスト記録を行うものであってもよい。

【0010】

この構成においては、追記型光ディスクが記録装置にセットされた後の1回目のパワーキャリブレーション動作においては、シーザ光の出力の最大値から最小値までの全ての段階におけるパワーレベルのシーザ光でテスト信号を記録し、これらテスト信号を再生した再生信号と基準信号とを比較して、両者が一致したものを最適パワーベルとして検出し、この最適パワーレベルを記憶手段に記憶すると共に、この最適パワーレベルのレーザ光を用いてデータエリアに対して追記記録動作を行う。次に、2回目以降のパワーキャリブレーション動作においては、記憶手段に記憶されている前回の最適パワーベルを中心とした前後所定範囲の段階のパワーベルのレーザ光でテスト記録を行う。

【0011】

また、上記最適パワーレベルを中心とした前後所定範囲の各段階のパワーレベルにおける再生信号がターゲット値よりも大きい場合には、よりパワーレベルの低い所定段階のシーザ光によりテスト記録を行い、また、前記最適パワーレベルを中心とした前後所定範囲の各段階のパワーベルにおける再生信号がターゲット値よりも小さい場合には、よりパワーレベルの高い所定段階のシーザ光によりテスト記録を行うものであってもよい。

【0012】

また、上記テスト記録手段は、レーザ光のパワーレベルの最大値と最小値との間を15段階に分割した各段階におけるパワーベルのレーザ光でフレームに対してテスト信号を記録し得るようになっており、記憶手段内に記憶された最適パワーレベルを中心とした前後1段階のパワーベルのレーザ光によりテスト記録を行うものであることが望ましい。

【0013】

【考案の実施の形態】

以下、本考案の一実施形態による追記型光ディスク記録装置について、図面を参照して説明する。追記型光ディスク記録装置の電気的構成を図1に示す。追記型光ディスク記録装置1は、最適な記録レーザ光のパワーレベルを検出するパワー・キャリブレーション機能を有し、この最適パワーレベルのレーザ光を使って、パケット方式によりファイル単位で各種データを記録し得るものである。記録装置1の全体の制御を司る中央処理装置3（以下、CPUと記す）には記録制御回路4が接続されており、この記録制御回路4は、CPU3からの制御信号とエンコーダ5からのテスト信号を受けて、レーザ駆動回路6及びサーボ回路7に駆動制御信号を出力する。エンコーダ5は、書き込み対象となる情報をEFM（Eight to Fourteen Modulation）信号に変換して出力するものである。また、光ピックアップ8は、半導体レーザ（不図示）を内蔵し、この半導体レーザからのレーザ光を集光して、光ディスク2上の目標の位置にレーザ光を照射すると共に、反射光を電気信号に変換して情報を再生するユニットである。この光ピックアップ8の半導体レーザは、レーザ駆動回路6からの通電制御により制御されており、また、この光ピックアップ8の位置制御はサーボ回路7により行われる。これら記録制御回路4、エンコーダ5、レーザ駆動回路6、サーボ回路7、光ピックアップ8は本考案のテスト記録手段を構成する。

【0014】

RF増幅回路10は、光ピックアップ8からの電気信号を増幅・復調するものであり、通常の再生動作時においては、このRF増幅回路10からの信号はCPU3に送られ、また、OPC動作時には、β検出回路11に送られるようになっている。β検出回路11と比較回路12とは、本考案の最適パワーレベル検出手段を構成するものであり、β検出回路11はRF増幅回路10から入力されたRF信号のピーク値、即ち、極大値Aと極小値Bを測定し、次式によってβ値（再生信号）を検出する。

$$\beta \text{ 値} = (A + B) / (A - B)$$

また、このβ検出回路11において検出されたβ値は、CPU3（最適パワー

レベル検出手段)においてターゲット値とする β 値と比較される。RAM14(記憶手段)は、OPC動作において検出された最適パワーレベルを記憶するものである。また、CPU3には、光ディスク2を回転させるモータ15を制御する回転制御回路16、光ディスク2が載せられるトレイを出し入れするためのCDトレイ開閉スイッチ17が接続されている。

【0015】

次に、光ディスクの構成を図2に、追記型光ディスク記録装置1のOPC動作を示すフローチャートを図3に示し、これらを参照して上記構成でなる追記型光ディスク記録装置1のOPC動作について説明する。図2に示すように、PCA50のテストエリア50aは、100個のパーティションP001～P100に分けられ、各パーティションP001～P100は15個のフレームF1～F15から構成される。このOPC動作は、追記型光ディスク2のデータエリア46への各種データの追記記録を開始する際、又は数個のファイルが記録される毎に随時行われるものである。

【0016】

追記型光ディスク2がトレイに載せられ、CDトレイ開閉スイッチ17が操作されて、追記型光ディスク2がセットされると、CPU3は、まず、レーザパワーを初期値に設定してからPCAのテストエリア50aにサーチし(S1)、パーティションP001を構成する15個のフレームF1～F15に対して15段階のパワーレベルのレーザ光でテスト信号を記録する(S2)。このときのパワーレベルは、レーザ光の出力の最大値と最小値との間を15分割した15段階のパワーレベルPW1～PW15となっている。次に、これらフレームF1～F15に記録したテスト信号を再生し、 β 検出回路11により各パワーレベルPW1～PW15における β 値を算出し、この β 値はターゲット値とする β 値とCPU3において比較され、両者が一致するパワーレベルを最適パワーレベルとして決定する(S3)。以上で第1回目のOPC動作が終了し、この最適パワーレベルのレーザ光で光ディスク2のデータエリア46に各種データの追記記録を行うと共に、この最適パワーレベルをRAM14に記憶する(S4)。なお、図2においては、PW7を最適パワーレベルとしている。

【0017】

次に、パケット方式によりデータエリア4.6に数個ファイルが記録されると、2回目のO P C動作を行う。このO P C動作においては、C P U 3は、R A M 14に記憶された最適パワーレベルP W 7を中心として前後1レベルのパワーレベルP W 6～P W 8を有するレーザ光で第2のパーティションP 0 0 2の3つのフレームF 1～F 3に対してテスト記録を行い(S 5)、これら3つのフレームF 1～F 3に記録したテスト信号を再生し、 β 値を算出する(S 6)。ここで、これら3つの β 値のうちの一つがターゲット値と一致した場合には(S 7でY E S)、一致した β 値におけるパワーレベルを最適パワーレベルとして決定する(S 8)。以上で第2回目のO P C動作が終了し、この最適パワーレベルのレーザ光でデータエリア4.6に追記記録を行う(S 9)。

【0018】

S 7において、3つの β 値のいずれもがターゲット値と一致しなかった場合には(S 7でN O)、S 8に進む。ここで、3つの β 値がターゲット値よりも小さい場合には(S 1 1でN O)、テスト信号のパワーレベルが低すぎたと判断して、図2に示すように、先程よりもパワーレベルの高い3つのステップのレーザ光(P W 9～P W 11)により3つのフレームF 4～F 6に対してテスト記録を行ってから(S 1 2)、S 6に戻り、再度、 β 値の算出、及び β 値のターゲット値との比較を行う。一方、S 1 1において、3つの β 値がターゲット値よりも大きい場合には(S 1 1でY E S)、テスト信号のパワーレベルが高すぎたと判断して、先程よりもパワーレベルの低い3つのステップのレーザ光により3つのフレームに対してテスト記録を行ってから(S 1 3)、S 6に戻る。

【0019】

C Dトレイ開閉スイッチ17が操作されず、同一の光ディスク2が装置内にセットされている時は(S 1 0でN O)、S 5に戻り、上述のS 5～S 1 3に示したような3段階のパワーレベルのレーザ光により3つのフレームを使って、O P C動作を行う。一方、C Dトレイ開閉スイッチ17が操作され、光ディスク2が取り出されたことが検知された場合には、S 1に戻り、再度、15段階のパワーレベルP W 1～P W 1 5のレーザ光により15個のフレームを使って、O P C動

作を行う。

【0020】

このように、前回のO P C動作により得られた最適パワーレベルを記憶しておき、この最適パワーレベルを中心とした前後1段階のパワーレベルによりテスト記録を行うようにしたので、2回目以降のO P C動作においては、3つのフレームのみがテスト記録を用いられることとなる。これにより、従来よりも少ないテストエリア50aで1回のO P C動作を行うことができるので、1枚の追記型光ディスク2で従来よりも多回数のO P C動作を行うことが可能となる。また、バケットライト方式のような記録方式を採用した場合においても、テストエリア50aが不足するような事態が起きることはない。

【0021】

また、再生信号を β 検出回路を通して算出された β 値がターゲット値と一致しなかった場合でも、パワーレベルを調整して、再度所定段階のパワーレベルでテスト記録を行うようにしたので、最適パワーンベルの検出ミスをなくし、誤ったパワーによる記録ミスを減らすことができる。

【0022】

なお、本考案は上記の実施形態に限られず種々の変形が可能である。例えば、上記実施形態においては、2回目以降のO P C動作において、前回のO P C動作において得られた最適パワーンベルを中心とした前後1段階のパワーレベルのレーザ光によりテスト記録動作を行うものとしたが、本考案はこれに限られるものではなく、最適パワーレベルを中心として前後2段階以上のパワーンベルのレーザ光でテスト記録を行うものであってもよい。

【0023】

【考案の効果】

以上のように、本考案に係る追記型光ディスク記録装置によれば、前回のパワーキャリブレーション動作により得られた最適パワーレベルを記憶しておき、この最適パワーンベルを中心とした前後所定範囲の段階のパワーンベルによりテスト記録を行うようにしたので、従来よりも少ないパワーキャリブレーションエリア領域で1回のパワーキャリブレーション動作を行うことが可能となり、1枚の

追記型光ディスクに対して従来よりも多回数のパワーキャリブレーション動作を行うことが可能となる。これにより、パケットライト方式の記録方式を採用した場合においても、テストエリアが不足して、パワーキャリブレーション動作を行うことができなくなるというような事態の発生を防ぐことができる。

【0024】

また、1回目のパワーキャリブレーション動作においては、全ての段階におけるパワーレベルでテスト記録を行い、2回目以降のパワーキャリブレーション動作においては、前回のパワーキャリブレーション動作において検出された最適パワーを中心とした前後所定範囲のパワーレベルでテスト記録を行うものとすることにより、2回目以降のパワーキャリブレーション動作においては、従来よりも少ないテストエリアで1回のパワーキャリブレーション動作を行うことが可能となり、上述の請求項1と同様の効果を得ることができる。

【0025】

また、再生信号が基準信号と一致しなかった場合でも、パワーベンベルを調整して、再度所定段階のパワーレベルでテスト記録を行うものとすることにより、最適パワーレベルの検出ミスをなくし、誤ったパワーによる記録ミスを減らすことができる。

【0026】

また、テスト記録手段は、15段階のパワーベンベルのレーザ光でテスト記録動作を行い得るものとし、最適パワーレベルを中心とした前後1段階のパワーレベルでテスト記録を行うものとすることにより、3つのフレームで1回のパワーキャリブレーション動作を行うことが可能となるので、1枚の追記型光ディスクに対して従来よりも多回数のパワーキャリブレーション動作を行うことが可能となり、上述の請求項1と同様の効果を得ることができる。